ShowerReco update - progress report

Andrzej Szelc

ShowerReco package

- Started by B. Rossi, who has now left Bern

- Reconstructed 3D angles of showers and calculated De/Dx of initial 5cm (arbitrary).

- Worked for ArgoNeut geometry only.

- The version in the repositories worked only for shower events (not connected to shower or shower start finding).

Upgrade to 3 plane geometry

- Upgraded Biagio's code to 3 planes generalizing the formulas calculated by Ornella and Maddalena:

$$\phi = \arctan(n/l)$$

$$\theta = \arccos \frac{m}{\sqrt{(l^2 + m^2 + n^2)}}$$

2 Planes

$$l = 1$$

$$m = \frac{1}{2\sin\alpha}\left(\frac{1}{\Omega_C} - \frac{1}{\Omega_I}\right)$$

$$n = \frac{1}{2\cos\alpha}\left(\frac{1}{\Omega_C} + \frac{1}{\Omega_I}\right)$$

Alpha_0 = 0 if one of the two planes is vertical
Else it is the smaller of the two

l,m,n are basically the x,y,z Coords, respectively.

3 Planes

$$l = 1$$

$$m = \frac{1}{2\sin\alpha_1}\left(\frac{\cos\alpha_1}{\Omega_0\cos\alpha_0}\frac{1}{\Omega_1} + sgn(!\alpha_0)\left(\frac{\cos\alpha_1}{\Omega_0} - \frac{1}{\Omega_1}\right)\right)$$

$$n = \frac{1}{2\cos\alpha_0}\left(\frac{1}{\Omega_0}\frac{1}{\Omega_1} + sgn(!\alpha_0)\left(\frac{1}{\Omega_0} - \frac{1}{\Omega_1}\right)\right)$$

The formulas need to be rechecked after the plane reordering

Other additions

- New module AngleShowerCluster (in ClusterFinder)– should create 2D cluster for each view corresponding to the shower and save the dTdW value. (Possibly Roxanne's ShowerFinder should go here).

  This should ID shower like clusters in each plane, find their start and 2D angle.
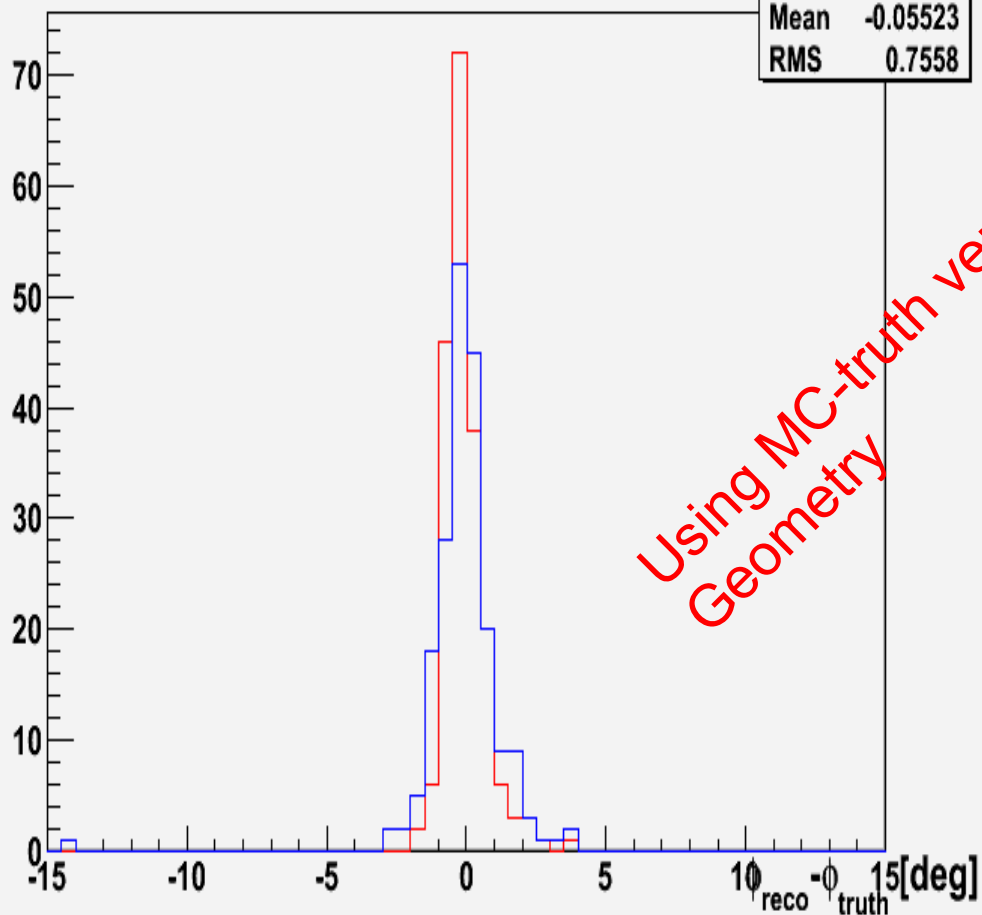
- ShowerReco now uses info from ShowerAngleCluster and only does 3D angle reconstruction and (in principle De/Dx calculations) and saves a recob::Shower object

- Thanks to Brian R. now the evd displays the shower and it's angle – useful for debugging.
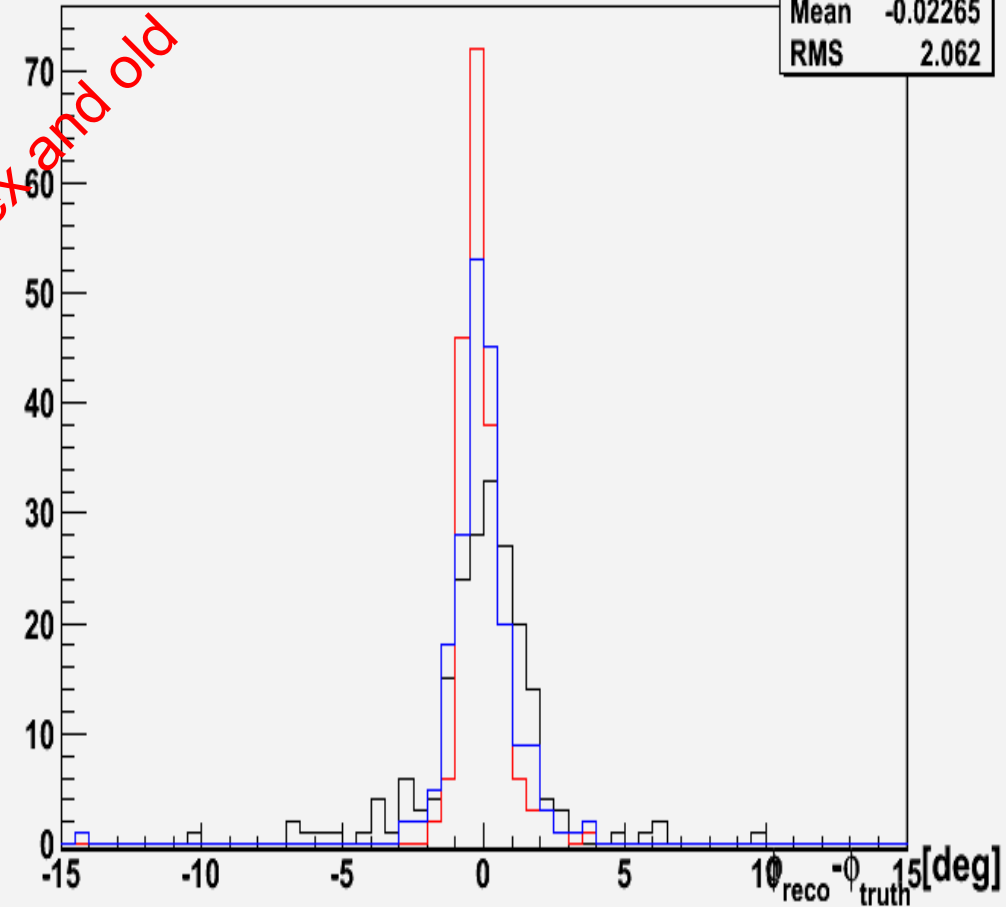
2D angle determination + display
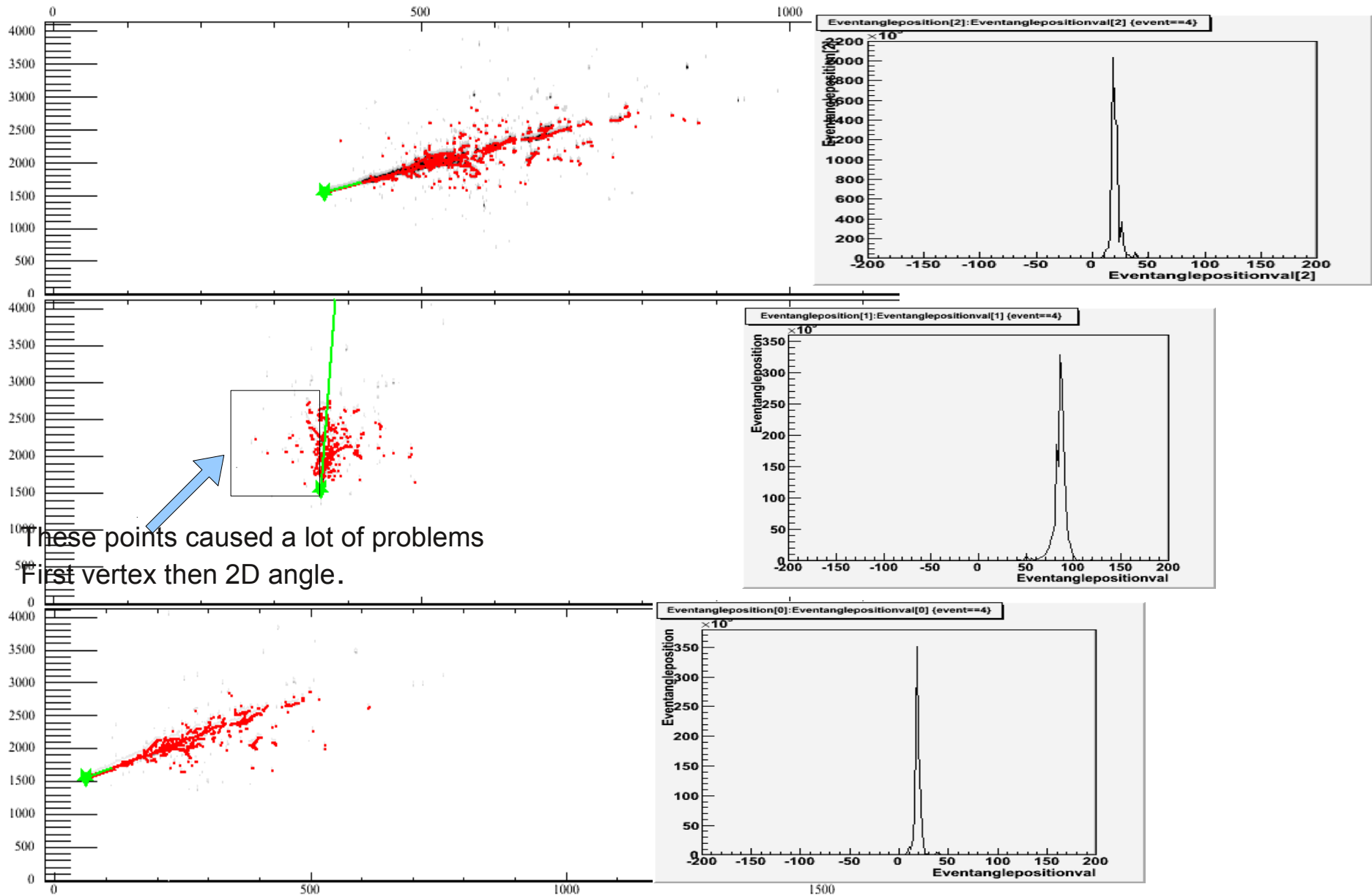
These points caused a lot of problems
First vertex then 2D angle.

New 3D angles

Preliminary shower start finding

- Simple algorithm with fitting a line through the shower if the correlation factor is big enough.

- For bad cases i.e. high angle in 2D view, the start gets projected from 3D coords from the other two planes.

- Seems to work reasonably for 2GeV showers.

- Need to test it further and fine tune.
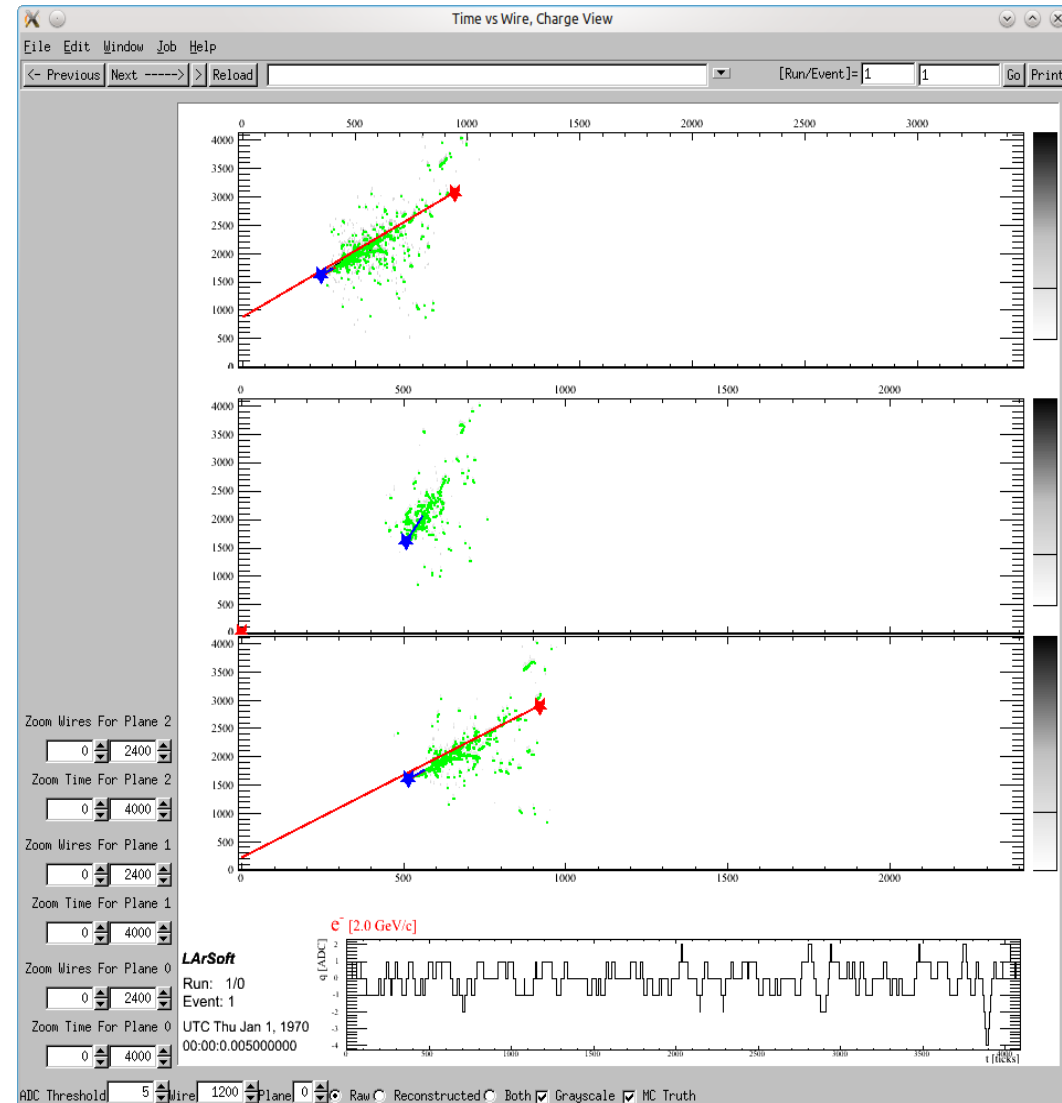
Next Steps

- Now that the vertex finding seems to work:

- See if it needs optimizing. Fine tune – try to catch weird events and see if I can make them work based on timing differences.

- Try to do: get an algorithm that recognizes 2D showers. Two approaches considered: if "shower start" finding works for non showers I can adapt Roxanne's code. If not, I might try to work with cluster parameters like correlation factor and RMS. Need to read up on other algorithms.

- try to find a way to assign 2D shower clusters to each other if there are more showers than one.

- Go back to ShowerReco – re-optimize 3D angle reconstruction after ShowerAngleCluster changes. Ornella's and Madda's formula vs. trying to determine a 3D prong in direction of the shower?

- if using formulas need calculation for phi~0

- Generate some real nu events and see what happens?